BIOSORPTION STUDY OF METHYLENE BLUES DYES USING E.SPINOSUM: INTERACTION STUDY BETWEEN pH, INITIAL CONCENTRATION AND DOSAGE

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SUPERVISOR'S DECLARATION

I hereby declare that I have checked this thesis and in my opinion, this thesis is adequate in terms of scope and quality for the award of the Bachelor Degree of Civil Engineering

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I hereby declare that the work in this thesis is based on my original work except for quotations and citations which have been duly acknowledged. I also declare that it has not been previously or concurrently submitted for any other degree at Universiti Malaysia Pahang or any other institutions.

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ABSTRAK

Penyingkiran pewarna dari industri telah menimbulkan minat yang mendalam di kalangan penyelidik dalam membangunkan teknologi kos rendah dan keberkesanan yang tinggi. Penyerapan yang menggunakan alga laut telah menjadi alternatif yang sesuai untuk mengeluarkan pewarna dalam larutan cecair. Kajian ini bertujuan untuk mengkaji interaksi parameter dan keadaan optimum. Parameter operasi yang terlibat ialah dos biomas (0.1-3g / L), kepekatan awal (5-150mg / L) dan pH (2-12). Prestasi penyerapan ditentukan dengan menjalankan eksperimen penyerapan berkumpulan. Hasilnya menunjukkan dimana dos biomas meningkat di samping itu peratusan penyingkiran juga turut meningkat tetapi pada had tertentu. Pelbagai pH tidak memberikan kesan yang besar kepada proses penyerapan. Dari data ujikaji, menunjukkan bahawa kepekatan awal berada pada 5mg / L dan dos optimum adalah dari pada pH 6. Maksimum peratusan penyingkiran pewarna di interaksi antara dos biomas dan kepekatan awal adalah 95% dah berada pada kepekatan 150mg/L. Dalam pada itu, untuk interaksi antara pH dan dos biomas, peratusan penyingkiran pewarna ialah 86% iaitu pada pH 6.

ABSTRACT

Removal of dyes from the industries has growing interest among the researchers in developing low cost and high efficiency technologies. Biosorption that using marine algae has become the ideal alternative for removing the dyes in aqueous solution. The study is aimed to the interaction of parameters and optimum conditions. The operating parameters that involved are biomass dosage (0.1-3g/L), initial concentration (5-150mg/L) and pH (2-12). The biosorption performance was determined by conducting the batch biosorption experiments. The results indicate as the biomass dosage increasing the percentage of removal also increasing. The variety of pH do not give a large effect to the biosorption process. From the experiment data, its show that the initial concentration is at 5mg/L and the optimum dosage is at pH 6. The maximum removal percentage for interaction between biomass dosage and initial concentration is 95% at concentration 150mg/L. Meanwhile, for the interaction between pH and biomass dosage, the maximum removal percentage is 86% at pH 6.

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LIST OF SYMBOLS

qe (mg/g)	Equilibrium biosorption capacity
Ci	Initial concentration
Ce	Equilibrium concentration
M	Mass of seaweed biomass
∀	Volume of MB dye
R, %	Percentage removal

LIST OF ABBREVIATIONS

H+	Hydrogen ion
OH-	Hydroxyl ion
DOE	Department Of Environment
BOD	Biochemical Oxygen Demand
COD	Chemical Oxygen Demand
MB	Methylene Blue
NaOH	Sodium hydroxide
HCl	Hydrochloric acid
USA	United States of America

CHAPTER 1

INTRODUCTION

1.1 Introduction

Recent years, an environment issue has become the main topic among the society in order to protect the environment for future. Many types of pollution had occurred such as air, water and soil because of the presence of chemical contamination. Every year, a huge amount of wastewater has been produced by many types of industries such as textile, food, paper, pharmaceutical and cosmetic that contain various organic and inorganic pollutants such as dye, that cause coloured waste water. The coloured wastewater discharged to the water resources and polluted the water resources. Figure 1.1 shows the number of river for each level of quality from 2005 until 2014. This environmental quality report was obtained from the Department of Environment. From this report, its show that the number of rivers that is clean had decreased from 2007 to 2014.

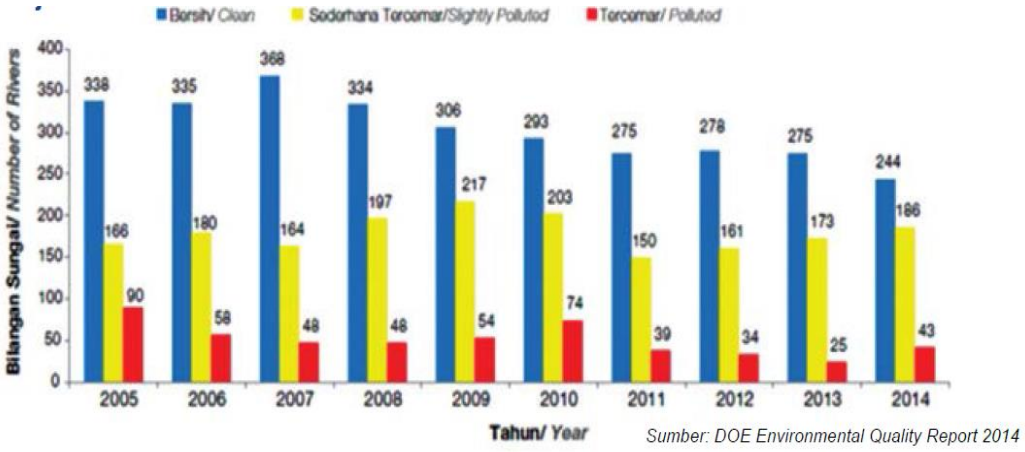

Figure 1.1: The Number of River for Each Level of Quality (DOE Environmental Quality Report, 2014)

Nowadays, about ten thousands of different dyes and pigments are used industrially and over 0.7 million tons of synthetic dyes are produced worldwide (Ehsan et al., 2012,). The industries that usually used synthetic dyes are textile, leather, cosmetics, food and also pharmaceuticals. Most of synthetic dyes are used in textile industry which is used to paint various fabrics. Dyeing effluents that comes from the dyes are the most hazardous component because the dyes are carcinogenic, toxic and mutagenic for humans and also other organisms. The Biochemical Oxygen Demand (BOD) and Chemical Oxygen Demand (COD) of water will increase because of the dyes in the wastewater. The toxicity of aquatic environment will also rise due to that dye is a toxic. These will cause severe health effect to human and also the animal that used the water such as central nervous system, disfunction of kidney and also reproductive system (Ehsan et al., 2012).

Some of these synthetic dyes are directly discharged into environment without any proper treatment by the industries. This is due to limitation of cost for the operation that has been applied by the industry to prevent the industry from loss. So, to cut the operation cost, the industry just discharged the wastewater that containing the dyes directly into river. Furthermore, the current cost for the treatment of the wastewater is high and some of the treatments are not an eco-friendly. If the treatment of the wastewater is conducted, the industry will need to increase the cost of the operation. This could make the industry loss due to the increase on the operation cost. Even some of the industry conducted the treatment

for the wastewater, the dyes are still presence in the wastewater. This is because the method that the industry used has low efficiency and just wasted the money. Therefore, a suitable low cost, eco-friendly and also has high efficiency method need to be suggested to treat the wastewater that containing dyes.

Figure 1.2: The River Polluted (Environmental Department, 2017)

Figure 1.3: The Waste Water Discharged into River (Environmental Department, 2017)

REFERENCES

A.A. Al-Homaidan, J. A.-H.-G. (2015). Adsorptive removal of cadmium ions by Spirulina platensis dry biomass. *Saudi Journal of Biological Sciences*, 795-800.

A.E. Navarro, R. F.-K. (2008). Effect of pH on phenol biosorption by marine seaweeds. *Journal of Hazardous Materials*, 405-411.

A.R. Khataee, F. V. (2013). Biosorption of three textile dyes from contaminated water by filamentous green algal Spirogyra sp.: Kinetic, isotherm and thermodynamic studies. *International Biodeterioration & Biodegradation*, 33-40.

American Carrageenan Technology System Incorporation. (2012). *ACTS Inc-Raw material*. Retrieved from PNG Carrageenan is derived from these two types of Eucheuma seaweed species: http://www.actsinc.biz/seaweed.html

Carlos E. Flores-Chaparro, L. F.-D.-M. (2017). Biosorption removal of benzene and toluene by three dried macroalgae at different ionic strength and temperatures: Algae biochemical composition and kinetics. *Journal of Environmental Management*, 126-135.

E.Daneshvar, A.Vazirzadeh, A.Niazi, M.Sillanpaa, & A.Bhatnagar. (2016). Chemical Engineering Journal. *A comparative study of methylene blue biosorption using different modified brown, red, green microalgae- Effect of pretreatment*.

E.Daneshvar, M.Kousha, M.Jokar, N.Koutahzadeh, & E.Guibal. (2012). Chemical Engineering Journal. *Acidic Dye Biosorption onto Marine Brown Macroalgae: Isotherms, Kinetic and Thermodynamics Studies*.

E.Daneshvar, M.Kousha, M.S.Sohrabi, A.Khataee, & A.Converti. (2012). Chemical Engineering Journal. *Biosorption of three acid dyes by brown macroalgae Stoechospermum marginatum: Isotherm, kinetic and thermodynmaic stuides*.

F.Vendruscolo, G. L. (2017). Biosorption of hexavalent chromium by microorganisms. *International Biodeterioration & Biodegradation*, 87-95.

H.Abu Hasan, S. A. (2016). Interaction of environmental factors on simultaneous biosorption of lead and manganese ions by locally isolated Bacillus cereus. *Journal of Industrial and Engineering Chemistry*, 295-305.

I. Morosanu, C. P. (2017). Biosorption of lead ions from aqueous effluents by rapeseed biomass. *New Biotechnology*, 110-124.

J. S. Varshini C, D. D. (2015). Optimization of parameters for praseodymium(III) biosorption onto biowaste materials using response surface methodology: Equilibrium, kinetic and regeneration studies. *Ecological Engineering*, 321-327.

M. K. Ab Ismail, M. A. (2016). Advance in Applied Science. *Investigations on the Cytotoxicity, Neurotoxicity and*, 47.

M. Rathod, K. M. (2014). Efficient removal of phosphate from aqueous solutions by red seaweed, Kappaphycus alverezii. *Journal of Cleaner Production*, 484-493.

M.Fomina, G. M. (2014). Biosorption: current perspectives on concept, definition and application. *Bioresource Technology*, 3-14.

M.H.Marzbali, A.A.Mir, M.Pazoki, R.Pourjamshidian, & M.Tabeshnia. (2017). Journal of Environmental Chemical Engineering. *Removal of direct yellow 12 from aqueous solution by adsorption onto spirulina algae as a high-efficiency adsorbent*.

N. M. Salem, A. M. (2014). Biosorption of Ni(II) from electroplating wastewater by modified (Eriobotrya japonica) loquat bark. *Journal of Saudi Chemical Society*, 379-386.

N.Mokhtar, E.A.Aziz, A.Aris, W.F.W.Ishak, & Ali, N. (2017). Journal of Environmental Chemical Engineering. *Biosorption of azo-dye using marine macro-alga of Euchema Spinosum*.

Niemeyer, K. (2 February, 2012). *ars Technica*. Retrieved from Engineered E. coli produce biofuel from seaweed: https://arstechnica.com/science/2012/02/engineered-e-coli-produces-ethanol-from-seaweed/

R. Kabbout, S. T. (2014). Biodecolorization of textile dye effluent by biosorption on fungal biomass materials. *International Conference on Material Sciences*, 437-444.

Rezaei, H. (2016). Biosorption of chromium by using Spirulina sp. *Arabian Journal of Chemistry*, 846-853.

S. Ortiz-Monsalve, J. D.-C. (2017). Biodecolourisation and biodegradation of leatherdyes by a native isolate of Trametes villosa. *Process Safety and Environmental Protection*, 437-451.

SEAWEED UNIDIP. (2013). *SEAWEED UNIDIP*. Retrieved from Know your Seaweed! : Kappaphycus alvarezii / Eucheuma cottonii: http://seaweed-undip.blogspot.my/2013/04/know-your-seaweed-kappaphycus-alvarezii.html

T. Akar, S. T. (2016). Treatment design and characteristics of a biosorptive decolourization process by a green type sorbent. *Journal of Cleaner Production*, 4844-4853.

Z. Aksu, E. B. (2010). Effect of salinity on metal-complex dye biosorption by Rhizopus arrhizus. *Journal of Environmental Management*, 1546-1555.